

Claims 11, 12, 14-16, 18-20, 22 and 24-33 are presented for consideration. Claims 11, 18, 27 and 28 are independent. Claims 13, 17, 21 and 23 have been canceled without prejudice or disclaimer. Claims 11, 12, 14, 16, 18, 20, 22, 24 and 26-29 have been amended to clarify features of the invention, while claims 30-33 have been added to recite additional features of the invention. Support for these changes and claims can be found in the application, as filed. Therefore, no new matter has been added.

Applicant requests favorable reconsideration and withdrawal of the rejections set forth in the above-noted Office Action.

Claims 11-13 were rejected under 35 U.S.C. § 102 as being anticipated by U.S. Patent No. 5,040,896 to Moslehi. Claims 14 and 15 were rejected under 35 U.S.C. § 103 as being unpatentable over the Moslehi patent in view of U.S. Patent No. 5,117,433 to Tatsuno et al. Claims 16 and 17 were rejected under 35 U.S.C. § 103 as being unpatentable over the Moslehi patent in view of U.S. Patent No. 5,696,628 to Sutton et al. Also, claims 18-21 and 26-29 were rejected under 35 U.S.C. § 103 as being unpatentable over U.S. Patent No. 6,057,970 to Kim et al. in view of the Moslehi patent. Claims 22, 23, and 26 were rejected under 35 U.S.C. § 103 as being unpatentable over the Kim et al. patent in view of the Moslehi patent and the Tatsuno et al. patent. Claims 24-26 were rejected under 35 U.S.C. § 103 as being unpatentable over the Kim et al. patent in view of the Moshlehi patent and the Sutton et al. patent. Applicant submits that the cited art, whether taken individually or in combination, does not teach many features of the present invention, as previously recited in claims 11-29. Therefore, these rejections are

respectfully traversed. Nevertheless, Applicant submits that independent claims 11, 18, 27 and 28 amplify the distinctions between the present invention and the cited art.

In one aspect of the invention, independent claim 11 recites an optical system for use in a projection exposure apparatus. The optical system includes a plurality of lenses having birefringence and at least one optical element for substantially correcting the birefringence of the plurality of lenses.

In another aspect of the invention, independent claim 18 recites a projection exposure apparatus that includes an illumination system for illuminating a reticle with light and a projection optical system for projecting a pattern of the reticle onto a wafer. The projection optical system includes a plurality of lenses having birefringence and at least one optical element for substantially correcting the birefringence of the plurality of lenses.

In still another aspect of the invention, independent claim 27 recites an optical system for use in a projection exposure apparatus. The optical system includes a plurality of optical elements each having birefringence, with the plurality of optical elements being arranged so that the birefringence is substantially corrected as a whole.

In still another aspect of the invention, independent claim 28 recites a projection exposure apparatus that includes an illumination system for illuminating a reticle with light and a projection optical system for projecting a pattern of the reticle onto a wafer. The projection optical system has a plurality of optical elements each having birefringence, with the plurality of optical elements being arranged so that the birefringence is substantially corrected as a whole.

Applicant submits that the cited art, whether taken individually or in combination, does not teach such features of the present invention, as recited in independent claims 11, 18, 27 and 28.

The Moslehi patent shows a three-crystal temperature-compensated reference interferometer for source wavelength stabilization. The Examiner takes the position that the Moslehi patent shows a projection optical system with a plurality of optical elements and “correcting means for correcting birefringence of the optical elements.” This contention is respectfully traversed.

The Moslehi patent shows a method and an apparatus for wavelength stabilization of an optical source by using three birefringent crystals that are temperature-compensated as a whole to function as the two arms of the reference interferometer. Synchronous detection of a light intensity signal representative of the phase difference between light waves of orthogonal polarization is made possible by making one of the three crystals an electro-optic material and applying a modulating voltage to it. The remaining two crystals are a pair of different passive birefringent crystals. The three interferometer crystals are cut and polished to prescribed lengths and orientations and optical path length changes with temperature in one crystal are compensated for by opposite and equal optical path length changes in the other two. Further, the Moslehi patent asserts that to “maximize the sensitivity of the interferometer to variations in the source wavelength the three-crystal system is designed to function as a quarter-wave plate at the effective source emission wavelength.”

The Moslehi patent, therefore, merely teaches that an interferometer 40 comprising three birefringent elements 34, 36 and 38, has a function of a quarter wave plate. In the Moslehi patent, however, the birefringence in these optical elements is produced positively. Therefore, in that patent and specifically, in the interferometer 40, the birefringence is not corrected. In more detail, there is no optical element in the Moslehi patent that serves to correct the birefringence of the three birefringent elements.

In addition, as discussed above, the Moslehi patent seeks to correct any change in optical path length due to a change in temperature of the birefringent element 34, on the basis of a change in optical path length due to a change in temperature of the paired birefringent elements 36 and 38. This correction in optical path length does not teach or suggest correction of birefringence in those birefringent elements.

For the reasons noted above, Applicant submits that Moslehi patent does not teach or suggest the salient features of Applicant's present invention, as recited in independent claims 11, 18, 27 and 28, including at least the feature of substantially correcting the birefringence in the optical elements.

Applicant further submits that the remaining art cited likewise does not teach or suggest such features of the present invention, as recited in the independent claims.

The Kim et al. patent, for example, relates to an apparatus for enhancing the depth of focus using a birefringent material. Specifically, that patent discusses producing plural focuses by the birefringence of a birefringent element 210, to thereby improve the depth of focus. In more detail, the Kim et al. patent shows a lithography apparatus that includes an optical lens

system in which an image of a photomask is transferred to an object by a light source, wherein the optical lens system includes a plurality of isotropic optical units and at least one birefringent optical unit. That birefringent optical unit includes at least one of the birefringent optical components. Applicant submits, however, that the Kim et al. patent, as with the Moslehi patent, does not teach or suggest anything regarding correcting birefringence of optical elements, in the manner of the present invention recited in the independent claims.

Still further, it is paramount in the device in the Kim et al. patent to maintain the birefringence of the optical elements. Accordingly, Applicant submits that one having ordinary skill in the art, upon reading the disclosure of the Kim et al. patent, would not be led to modify the device in that patent by providing that device with anything that would change or correct this birefringence. Accordingly, Applicant submits that a combination of the teachings of the Kim et al. patent and Moslehi patent is unfounded. Specifically, such a combination would be impractical, clearly, because if an element for correcting birefringence (assuming that such an element were taught in the Moslehi patent) were introduced into the device in the Kim et al. patent, the plural focuses would disappear and only a single focus would be produced. This is contrary to the express teachings in the Kim et al. patent.

Applicant submits that the remaining art cited does not cure the deficiencies noted above with respect to the Moslehi and Kim et al. patents.

The Examiner relies on the Tatsuno et al. patent for the use of a diffraction grating on the surface of an optical element to produce birefringence, and the Sutton et al. patent for teaching that a producing a predetermined stress distribution in an optical element is effective in

producing birefringence. These patents, however, as with the remaining art cited do not teach or suggest correcting birefringence of a plurality of lenses in the manner of the present invention recited in the independent claims. Therefore, these patents add nothing to the teachings of the art discussed above, that would render obvious Applicant's present invention recited in the independent claims.

For the foregoing reasons, Applicant submits that the present invention, as recited in independent claims 11, 18, 27 and 28, is patentably defined over the cited art, whether that art is taken individually or in combination.

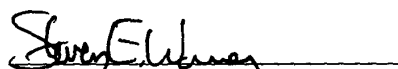
The dependent claims also should be deemed allowable, in their own right, for defining other patentable features of the present invention in addition to those recited in their respective independent claims. Individual consideration of these dependent claims is requested.

Applicant submits that this Amendment After Final Rejection clearly places this application in condition for allowance. This Amendment was not earlier presented because Applicant believed that the prior Amendment placed the application in condition for allowance. Accordingly, entry of the instant Amendment, as an earnest attempt to advance prosecution and reduce the number of issues, is requested under 37 CFR 1.116.

Favorable reconsideration, withdrawal of the rejections set forth in the above-noted Office Action and an early Notice of Allowance are also requested.

Applicant's undersigned attorney may be reached in our Washington, D.C. office by telephone at (202) 530-1010. All correspondence should be directed to our address listed below.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "Steven E. Warner", is written over a horizontal line.

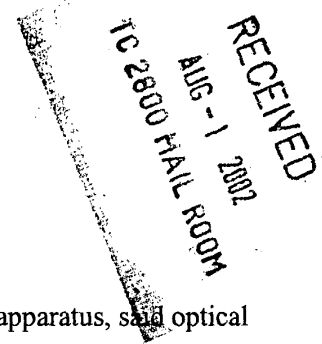
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Application No. 09/523,735
Attorney Docket No. 00684.002700.1



APPENDIX A

IN THE CLAIMS

11. (Amended) An optical system for use in a projection exposure apparatus, said optical system comprising:

a plurality of lenses having birefringence; and

at least one optical element for substantially correcting the birefringence of said plurality of lenses.

12. (Amended) An optical system according to claim 11, wherein said at least one optical element [comprises at least one optical member having predetermined] has form birefringence.

14. (Amended) An optical system according to claim 12, wherein said at least one optical [member is arranged to produce] element produces the form birefringence [on the basis of] by a grating having a period smaller than a wavelength used.

16. (Amended) An optical system according to claim 11, wherein said at least one optical element [comprises at least one optical member having a predetermined] has a stress distribution.

18. (Amended) A projection exposure apparatus comprising:
an illumination system for illuminating a reticle with light; and
a projection optical system for projecting a pattern of the reticle onto a wafer, said projection optical system including a plurality of lenses having birefringence, and at least one optical element for substantially correcting the birefringence of said plurality of lenses.

20. (Amended) A projection exposure apparatus according to claim 18, wherein said at least one optical element [comprises at least one optical member having predetermined] has form birefringence.

22. (Amended) A projection exposure apparatus according to claim 20, wherein said at least one optical [member is arranged to produce] element produces the form birefringence [on the basis of] by a grating having a period smaller than a wavelength used.

24. (Amended) A projection exposure apparatus according to claim 18, wherein said at least one [correcting element comprises at least one optical member having a predetermined] optical element has a stress distribution.

26. (Amended) A device manufacturing method [including a process for printing] comprising the steps of:

exposing a wafer to a device pattern [on a substrate] by use of a projection exposure apparatus as recited in [any one of claims 18 through 25] claim 18; and

developing the exposed wafer.

27. (Amended) An optical system for use in a projection exposure apparatus, said optical system comprising:

a plurality of optical elements [including lenses] each having birefringence, said plurality of optical elements being arranged so that the birefringence [can be] is substantially corrected as a whole.

28. (Amended) A projection exposure apparatus comprising:

an illumination system for illuminating a reticle with light; and

a projection optical system for projecting a pattern of the reticle onto a wafer, said projection optical system having a plurality of optical elements [including lenses] each having birefringence, and said plurality of optical elements being arranged so that the birefringence [can be] is substantially corrected as a whole.

29. (Amended) A device manufacturing method, comprising the steps of:

 exposing a wafer to a device pattern by use of a projection exposure apparatus as
recited in [any one of claims 18 through 25 and] claim 28; and
 developing the exposed wafer.

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